

On the Relationship of the Vertebrata and Annelida.

By C. SEMPER.

It is well known that the Ascidia are regarded with Kupfer and Kowalevsky as the nearest relatives of the Vertebrata; and this opinion is supported by the analogous mode of production of the nerve-cord and the presence of a chorda between it and the intestine in both groups of animals. But it is forgotten that the Vertebrata are segmented animals, while the Ascidia are not so: the sole indication of a segmentation in the latter appears to lie in the occurrence of spinal nerves in the tail and hinder part of the body of the larva of *Ascidia mentula*, as affirmed by Kupfer.

This gap is now filled in a most unexpected manner by the discovery of segmental organs in Selachian embryos. In *Acanthias*, *Centrina*, and *Scyllium* I have found funnel-shaped openings leading into ciliated ducts in connexion with the primitive kidneys; they are placed, one pair in each segment (*metamere*), right and left of the mesentery, along the whole of the body-cavity. They are produced by depression of the peritoneal epithelium, and are only secondarily connected with the lateral canals of the primitive renal duct, which also issue segmentally. The funnels in *Acanthias* are very large; and their cilia vibrate strongly. In *Centrina* and *Acanthias* they may be detected by the lens even in nearly mature embryos; in *Scyllium*, on the contrary, they disappear very early. In *Acanthias* the ovary is developed without any participation of the segmental organs; but in the male the seminal duct seems to become developed by a peculiar process of budding and amalgamation of the segmental funnels.

Except in a single point, the comparison to the segmental organ of an annelide may be completely carried out. In the one, as in the other, they are repeated in pairs in the segments of the body: they have a ciliated funnel opening freely into the cavity of the body; the ciliated duct springing from this leads into a glandular segment (in the Vertebrates to the Malpighian body or primitive kidney); they are in intimate relation with the genital organs; and, lastly, they are produced in their glandular and infundibular portion from the mesoderm. The sole distinction consists in the mode of opening of these excretory organs: in the Annelida each segmental organ opens separately in the corresponding segment of the body; in the Vertebrata they unite with the primitive renal duct, which in the Selachia, as in the Teleostea, is a product of the peritoneal epithelium. This contradiction cannot, however, be used as an argument against the comparison of the two sets of organs, as the union of the glandular part with the efferent ducts is in both cases produced secondarily by the coalescence of the original separate rudiments; moreover the so-called aquiferous vessels of the Rotatoria are universally compared to the segmental organs of the Vermes, although in the former, just as in the Vertebrata, two efferent ducts opening into the cloaca take up the secretion of the glands, which open by several funnels into the body-cavity.

It might appear that a statement of Gegenbaur's is to be referred

to these segmental organs. In his so-called 'Comparative Anatomy' he speaks of the possibility of a comparison of the oviducts and tubæ to the segmental organs of the Vermes. This is completely refuted by the observations here given: the true segmental organs of the Vertebrata (hitherto detected only in the Selachia) have nothing to do with the tubæ and the oviduct; the former originates from the primitive renal duct, and the latter is produced by a fold which finally leads to the formation of a tube; the tubæ are only the permanently open orifices of the primitive renal groove, and they consequently originate in quite a different manner from the true segmental funnels.

The comparison here made leads to far-reaching consequences. Assuming it to be correct, it follows that the Annelida are more nearly allied than the Ascidia to the Selachia, and therefore also to the Vertebrata in general (with the exception of *Amphioxus*). It might be objected that the spinal cord and the chorda are of more importance for the recognition of relationship than the primitive kidney and the segmentation of the body, so that the Ascidia are more nearly allied than the Vermes to the Vertebrata. But this objection is partly refuted by the circumstance that according to Kowalevsky's investigations the ventral cord of the Vermes and Insecta is formed in a perfectly analogous manner to the dorsal cord of the Vertebrata. The chorda alone seems to offer any difficulty; but it is still questionable whether the chorda of the Ascidia is really to be compared so unconditionally to that of the Vertebrata; and, on the other hand, Kowalevsky, in his 'Embryological Researches on Worms and Insects,' even indicated as a chorda a fibrous cord discovered by Leydig in the earthworm and detected by Claparède in numerous worms, and which in its origin and position between the ventral cord and the intestine exactly resembles the chorda of the Vertebrata. Nevertheless the histological structure of this cord is essentially different.

If the embryo of an annelide be turned so that its ventral surface lies upwards, its section presents exactly the same arrangement of the organs as in the Selachian embryo. Consequently, by the discovery of the segmental organs, the belly of the annulose animal is identified with the back of the vertebrate. This is not the place to trace this conception to its further consequences; in this respect, as also with regard to the detailed proof of the facts given above, reference must be made to a more complete memoir which will appear shortly in the second volume of the 'Arbeiten aus dem zoologisch-zootomischen Institut in Würzburg.'—*Centralbl. für die med. Wissenschaft.* 1874, No. 35.

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Segmental Organs in adult Selachia. By C. SEMPER.

I can now follow up my former preliminary communication on the occurrence of segmental organs in Selachian embryos with a further statement that such organs may also be very easily detected even in adult animals, but only in fresh or very well-preserved



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